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ANALYZING THE DECLINE IN AXOLOTL POPULATION AND ITS CONSERVATION

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ABSTRACT

The axolotl (Ambystoma mexicanum), a critically endangered salamander endemic to Mexico City, has garnered considerable scientific attention due to its remarkable regenerative abilities. However, there are various factors causing endangerment including overharvesting, pollution, habitat loss and so on. This project aims to analyze the status of axolotl populations and identify key factors driving their decline. By analyzing data obtained on the axolotls from various sources, it was determined that humans are a major cause of the endangerment of these axolotls. To tackle these threats, a conservation strategy is proposed including spread awareness, newer government policies, breeding programs, and so on. By applying these techniques, we can help assure the long-term survival of this species and its contributions to scientific research, especially in the field of medicine.

AIM

To analyze a specific unknown or uncommon species (axolotl), understand their importance to science, examine their endangerment and provide methods to reduce their endangerment.

KEYWORDS: Conservation, Axolotl, Regeneration, Pollution

INTRODUCTION

» **About axolotl:**

The axolotl (*Ambystoma mexicanum*) are amphibians that are related to the tiger salamander. They are found in lakes like Xochimilcan lake in Mexico City. These amphibians are unusual as they reach adulthood without undergoing metamorphosis due to which the adults stay aquatic and gilled. This aquatic amphibian is marked as critically endangered by the international union for conservation of nature (IUCN).

The axolotl reach reproductive maturity at the age of 18-24 months and their length varies from 15-45cm though a length of 23 cm is common and a length of 30cm is rare. Axolotls are long-lived, surviving up to 15 years on a diet of mollusks, worms, insect larvae, crustaceans, and some fish. Axolotls find food by smell and suck the food into their stomachs.

They also have external gills and a caudal fin (the fin which helps in propulsion) extending from behind the head to the vent. The axolotl's eyes are lid less and their heads are wide. Their limbs are also underdeveloped.
Male axolotl can be found be their swollen cloacae (opening for the digestive, reproductive, and urinary tracts) are lined with papillae. Females are noticeable from their wider bodies full of eggs. The main method of feeding is through suction, and respiration occurs through external gills as well as through the buccal pumping mechanism.

Axolotls have several pigmentation genes:

» The typical wild animal is brown with gold specks and an olive undercurrent.
» The five more common colors are
- Leucitic (pale pink with black eyes),
- Golden albino (golden with gold eyes),
- Xanthic (grey with black eyes),
- Albino (pale pink/white with red eyes)
- Melanoid (all dark blue).

The axolotl are native to the lake Xochimilco and the chalaco lake in the valley of Mexico. The water temperature in Xochimilco seldom exceeds 20 °C (68 °f), though it may fall between 6 and 7 °C in the winter.

MATERIALS AND METHODS

A large number of websites on the web were analyzed to

draw the following conclusions. This includes peer-reviewed scientific papers obtained from reliable sources like nature, ncbi, pnas and so on. Further relevant news articles are also taken into account particularly from conservation related sites like WWF (World wildlife Fund), PBS and so on as mentioned in the references. In order to conclude these results, the following steps were followed:

- Identification of sites to know more about the axolotl.
- Determine research papers specifying about the regenerative properties of the axolotl
- Using simple language to present the results of the analysis to help large sections of the society to understand the importance of axolotls and their applications in the medical world.

RESULT AND DISCUSSIONS

After careful analysis of endangerment data and observations made from various sources, the following inferences were obtained.

» Analysis of Population Decline

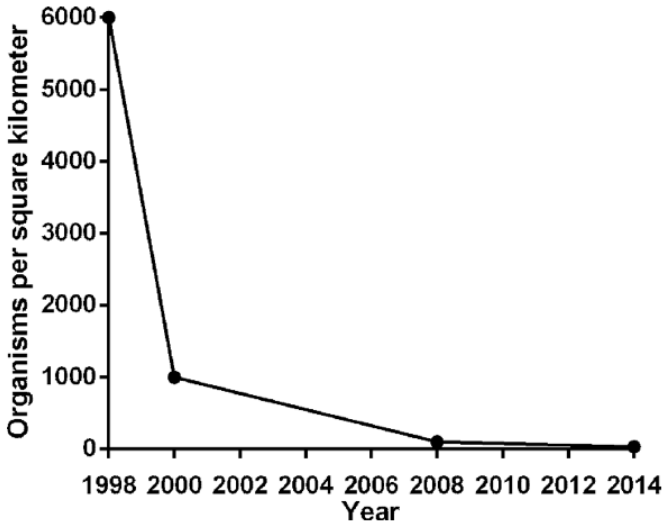

Table 1: Decline of population of axolotls per km sq. with time.

There has been an decrease in the population of about 90% from the years 1998 to 2008. This has been particularly linked with the increase in pollution in these lakes at this time. This is primarily due to the reasons mentioned above. This has also resulted in the decline of other species in the lakes.

» Reasons for endangerment

- Introduction of large fish in the axolotl's habitat has resulted in the shortage of food for the axolotl as they are not the top predators in their habitat as they initially were
- Demands of Mexico City has resulted in the drainage and pollution of lake Xochimilco.
    - Microplastics in the lake can enter axolotls and can potentially cause damage in the digestive systems of the axolotl.
    - Eutrophication due to fertilizer use in nearby fields also affect the axolotls by depleting oxygen levels.
    - Oxygen levels are also reduced due to the increased presence of organic wastes.
- These axolotls are used a lot as aquarium fish.
- Roasted axolotl is a delicacy in Mexico, shrinking their numbers. Importance of axolotls to the environment
- Axolotls play a significant role in genetic research due to their unique property of regenerating parts of their body.
- They also have many medicinal properties
- The axolotls are extensively used as a lab model for everything from repair to development and cancer.

» Pollution as a cause of endangerment

The following graph shows the correlation between the concentration of pollutants in a given lake and the effects of this pollution on various aspects of the axolotl like mortality rate, gill damage, population decline and so on.

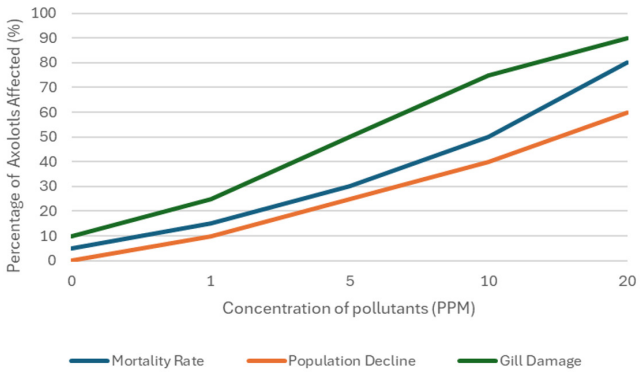

Table 2: Correlation between concentration of pollutants and overall axolotl health.

From the above graph it can be inferred that, pollutants in lake Xochimilco are important reasons for the decline of axolotls in the ecosystem. This can be seen due to the increase in mortality rate and population decline primarily even for a rise in about 3-4 ppm. Hence, axolotls are highly sensitive to pollution levels in the lake.

» Regeneration Properties of the Axolotl

The axolotl is an important model organism as it is a tetrapod and has a similar body plan to humans. Unlike humans, the axolotl can regenerate limbs, and other complex tissues. The axolotl contributes to understanding evolution, development, and regeneration.

The axolotl has an important property of regeneration which has enabled then to regenerate lost limbs. This property of the axolotl has puzzled scientists and they as a result have concluded that the axolotl stores information necessary for regeneration in their DNA this is the broad idea for the relation of DNA with the axolotl.

The process of regeneration of axolotls takes in the following steps:

- First, the axolotl seals the wounds with a layer of skin cells. This step is like other amphibians.
- A mass of undifferentiated tissue called the blastema is formed which can differentiate into any cell in the body.

- The blastema then undergoes rapid multiplication and division. While multiplying, the cells arrange themselves into the correct order to replicate the limb organ.
- Differentiation then takes place resulting in the formation of the limb or organ which was initially present in the region.

» **Some Methods to Protect and Increase the Numbers of the Wild Axolotl in the Mexican Waters.**

There are many methods to prevent axolotls and increase their numbers in the wild. They are as follows:

- Spreading Awareness: Axolotls can be protected in their environment by creating awareness among people about the axolotls and why they are important in the environment.
- Certain measures can also be taken to protect the axolotl in the Mexican waters like in lake Xochimilco.
- The water in Mexico can also be cleaned such that no drainage is released inside the lake. This allows the axolotl to survive.
- Various conservation efforts have already been put into place by various organizations including
    - Xochimilco Ecological Recovery and Conservation Project (Focusing on cleaning canals leading to the lakes to reduce pollution into the lakes).
    - Further, zoo breeding programs have been established for the axolotls for further enhancing the number of axolotls bred in captive and then released into the wild.
- On an individual level, reasonably sourced axolotls can be used as pets. Further, water pollution levels particularly in Mexico can be controlled

CONCLUSIONS

As observed, axolotls are of great significance not only for maintaining the food web but also in the scientific world. These axolotls may pose as the future to organ transplantations and may also be the only hope for developing regeneration techniques in humans. Implementing these methods of conservation are crucial to preserve these species to not only benefit the ecosystem but also the advancement in human medicine forever.

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